Sustainable Sites

Thoughtful site selection can help reduce the disruption to local plant and animal life, as well as help restore and enhance the surrounding environment. LEED Sustainable Sites credits encourage best practice measures through strategies such as alternative transportation, effective site lighting design, development of high-density and brownfield sites, and stormwater management. Many owners are also realizing financial benefits from choosing and maintaining a sustainable site, from tax incentives for brownfield development to reduced space conditioning by choosing cool roofing materials.

Frank H. Ricketson Jr. Law Building, home of the University of Denver Sturm College of Law, is the only Colorado project, to date, to receive LEED-NC Gold Certification.
Courtesy: H+L Architecture

SS Prerequisite 1: Erosion & Sedimentation Control

Nearly all cities require erosion and sedimentation control as part of the building code requirements. Control measures can include the use of silt fences, straw bales and sediment traps to minimize negative effects on receiving waters. The EPA defines a variety of "Best Management Practices" (BMPs). These practices are subdivided into two main categories:

- The exclusion of infiltrating surface water, and
- The exclusion of laterally migrating ground water.

Recommendations:

- The general contractor/construction manager should take photographs of the measures implemented to document achievement of this prerequisite.
- Successful Erosion Control Plans have included but are not limited to the following measures:
  - Minimize disturbance of current vegetation.
  - Use of free draining gravel on temporary roadway.
  - Temporary seeding to prevent soil loss.
  - Silt fence with straw bales.
  - Catch basin silt sack sediment trap.
  - Catch basin straw bale sediment trap.
  - Prompt planting of permanent vegetation upon completion.

Helpful Hints:

- Most cities require documentation of erosion control measures for permitting purposes. In general, there is no additional cost related to achieving the prerequisite, and is usually achieved with normal construction practice. Verify local code requirements and best management practices with the project's civil engineer.
- First time users often incorrectly assume the "Erosion & Sedimentation Control Plan" requested by LEED as supporting documentation is a lengthy and detailed narrative. Erosion and sedimentation control drawings and related construction details depicting erosion control measures in the Civil Engineering drawings will suffice.

QUICK FACTS

Implementation: Required.

Colorado Department of Labor and Employment
Silt fence minimizes construction disturbance

Example:

- The North Boulder Recreation Center achieved the prerequisite by stockpiling soil, and installing silt fences and detention ponds, straw bales and stone stabilization pads following the most stringent erosion control practices between the City of Boulder and the EPA BMPs.

Resources:

The Stormwater Manager's Resource Center
Fact Sheet- Erosion & Sedimentation Control
Website: www.stormwatercenter.net/

Arapahoe County's Grading, Erosion and Sediment Control Manual
Website:
www.co.arapahoe.co.us/Departments/PW/Engineering/GESC.asp

Referenced Standard: U.S. Environmental Protection Agency
Storm Water Management for Construction Activities, Chapter 3, Document No. EPA 832/R-92-005 (September 1992),
Website:
www.epa.gov/npdes/pubs/owm0307.pdf

SS Credit 1: Site Selection

Site selection is based on the previous uses and condition of the building site. Specific requirements are outlined in the LEED Rating System. In general, achievement of this credit is the responsibility of the land owner upon selection of the site.

Helpful Hints:

- This point is a generally a "go / no-go" point based on site criteria.
- The FEMA 100-year flood plain is most often the preventative requirement for many projects. Check the FEMA website early.
- It is also important to verify that the site is not located in prime farmland as defined by LEED.
- In cases where no data is available from FEMA, data from the Army Corps of Engineers is an acceptable alternative.
- The 100 foot setback from wetlands includes the location of wastewater treatment systems or other support systems (cooling towers etc.) for the building.

Resources:

U.S. Department of Agriculture Definition of Prime Agricultural Land as stated in U.S. Code of Federal Regulations
Website: www.gpoaccess.gov/cfr/index.html
(go to "Browse and/or search the CFR").

Colorado Prime Farmland
This resource is a map of Colorado counties with links to maps of Colorado farmland by county.
Website:
www.co.nrcs.usda.gov/technical/soil/important-farmlands/prime-farm-lands.html

Whole Building Design Guide
Guidance on using whole system approach to design, beginning with site selection.
Website:
www.wbdg.org/design/site_potential.php

QUICK FACTS

Implementation: Strongly recommended.

Historical Data: 71% of Colorado LEED certified projects have successfully earned this credit.

Federal Emergency Management Agency (FEMA) 100-Year Flood Definition
Includes a database of flood maps; searchable by address or region. Go to 'FEMA Flood Map Store' and then click on the 'Map Search' tab at the top of the Flood Map Store web page.
Website: www.fema.gov

Colorado Division of Wildlife
This website includes a Colorado listing of endangered, threatened and wildlife species of special concern, with links to specific animal habitats.
Website: wildlife.state.co.us/WildlifeSpecies/
(go to "Threatened & Endangered Species")

Definition of Wetlands in the U.S. Code of Federal Regulations:
"Wetlands consist of areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturate soil conditions."

Colorado Division of Wildlife
Colorado Wetlands Partnership
This website includes general information on wetlands, wetland types in Colorado and Wetlands Partnership site locations.
Website:
wildlife.state.co.us/LandWater/WetlandsProgram/WetlandsHome.htm

Public Parkland
Various websites exist for locating national parklands, including the following from NCSU Libraries.
Website: www.lib.ncsu.edu/gis/index.html

SS Credit 2: Development Density

The intent of the credit is to encourage high-density development to preserve open space and reduce urban sprawl. This credit can be difficult to achieve outside of major cities, since the project must be surrounded by the equivalent of two-story downtown development, though some exceptions have been made for smaller communities and for university and college buildings. The key is to develop in an area that is already within an urban environment.

Recommendations:

- Obtain a copy of the site/surrounding master plan to quickly assess whether the credit is even potentially viable. When the surrounding area is privately owned, information may be difficult to obtain. Local planning departments typically have this information. Aerial photographs, available on the internet, may also be of help.

Helpful Hints:

- Urban sites can be more expensive; however, this credit is not usually a driving factor for site selection. Typically, the site either fits the requirements or it doesn't, and thus does not add cost to a project.
- For locations that already have well-established infrastructure, it is acceptable to take into consideration future planned neighboring developments to determine the area's density (per requirements of Credit Interpretation Request (CIR) for SSc2 ruling dated 12/23/2002). In order to determine credit compliance in this situation, it is necessary to quantify that proposed future density, and document that the developments meet the density goals of the urban revitalization plan.
- Reference the USGBC CIRs for additional information.
- Note: Parking (structured or open) must be included in density calculations.
- Exclude roads and right-of-way areas as well as parks and water bodies from the calculations. See LEED Reference Guide for more information.

QUICK FACTS

Implementation: Strongly recommended.

Historical Data: 14% of Colorado LEED certified projects have successfully earned this credit.

Colorado Department of Labor and Employment
Courtesy: Colorado Department of Labor and Employment

- This credit is relevant in City infill projects or campus applications. The LEED Campus Application Guide requires, "the project complies with a regional or master planning effort to redevelop an area with existing infrastructure into a higher density area with an ultimate intended density that reflects local development conditions…On sites where the contiguous property is over 15 acres, the project may use the campus boundaries in lieu of a documentation circle to calculate density." LEED-NC projects in campus settings may use this approach as an *alternative compliance path* to achieving the credit.

Example:

- Colorado Department of Labor & Employment earned this credit by building a 40,000 square foot addition (in place of an existing parking structure) in downtown Denver.

Resources:

Colorado Sprawl Action Center
Growth Management Tool Kit
This resource lists a comprehensive table of contents with links to different issues dealing with urban development and growth management.
Website:
www.sprawlaction.org/toolkit/index.html

Planning Commissioners Journal
Sprawl Guide
This online Sprawl Guide is designed to familiarize you with key issues associated with sprawl, and direct you to some of the wealth of information available on the Web. The Colorado section includes links to the Boulder County Comprehensive Plan, Smart Growth & Development Initiatives and examples of communities using smart growth initiatives.
Website:
www.plannersweb.com/sprawl/place-co.html

Colorado Office of Smart Growth
This office provides direct technical and financial assistance to local governments in the areas of land use planning and growth management.
Website:
www.dola.state.co.us/SmartGrowth/

Google Earth
Google Earth combines satellite imagery, maps and the search features to provide tools that simplify development density calculations.
Website: earth.google.com

Starting a new LEED-NC project?
Beginning in January 2006, project registering with LEED-NC will use version 2.2, rather than version 2.1. Refer to the USGBC for version 2.2 details or see Appendix C of this Guide for a quick overview of major changes from version 2.1.

SS Credit 3: Brownfield Redevelopment

Whether or not a site is eligible for this point depends on its classification by the EPA or local jurisdictions, typically through an ASTM Environmental Site Assessment. It may also be possible to identify the existence of on-site containments through a Phase Two Environmental Site Assessment performed by an environmental professional (not associated with the project team.) In this case, a letter from the examining environmental professional may be sufficient to qualify the project for this LEED credit. The Phase Two Site Assessment should be made available as supporting documentation.

Recommendation:

- Readily achievable where real or perceived contamination may exist, such as former industrial sites or gas stations.

Helpful Hints:

- This point is achieved through *remediation* of the contamination on the site.
- Thoroughly document all remediation efforts.
- There is no requirement for a minimum quantity of pollution requiring mitigation.
- Contamination remediation can include removal of asbestos inside of a building.

Example:

- Belmar 2M3 project documented site contaminant remediation, and to date is the only Colorado project to date to achieve this credit.
- The GSA EPA Office Building in downtown Denver is pursuing this LEED credit based on the remediation of the site contamination from the previous owner, documented in a Phase Two Environmental Site Assessment.

Resources:

U.S. Environmental Protection Agency
Introduction to Brownfields
This resource includes information on the EPA's definition of a Brownfield site and links to many other Brownfield resources such as FAQs, grant information and tools for success.
Website:
www.epa.gov/region08/land_waste/bfhome/bfhome.html

QUICK FACTS

Implementation: Strongly recommended (if eligible).

Historical Data: 7% of Colorado LEED certified projects have successfully earned this credit.

Belmar 2M3
Courtesy: Continuum Development

Colorado Department of Public Health and the Environment
Brownfield Site Assessments and Colorado Brownfields
A public-private partnership, the Colorado Brownfields Revolving Loan Fund, encourages the cleanup of unused or underused contaminated properties. Provides state incentives through tax credit. Download *The Colorado Brownfields Handbook: A Local Government Guide to Site Reuse and Economic Redevelopment* (2005).
Website:
www.cdphe.state.co.us/hm/rpbrownfields.asp

NCAT - Smart Communities Network
This resource includes information on Brownfield success stories, case studies and benefits.
Website:
www.smartcommunities.ncat.org/landuse/brownf.shtml

Referenced Standard: ASTM E1903-97 Phase II Environmental Site Assessment
Website:
http://www.astm.org/cgi-bin/SoftCart.exe/DATABASE.CART/REDLINE_PAGES/E1903.htm?E+mystore

SS Credit 4.1: Alternative Transportation, Locate Near Public Transportation

Reducing car usage in or around the site can reduce the pollution and general land development impacts of the project both during construction and post-occupancy. Many populated areas in the Denver-metro area have strong public transportation systems already in place.

Recommendations:

- Confirm the minimum number of routes (two) is available to meet the credit. The existence of a convenient bus stop is not all that is needed.
- Project the distance from the main building entrances to public transit stops to determine if the distance required is feasible early in the project. This distance is measured by walking route, not radius.
- Confirm the RTD/mass transit map includes the number of routes necessary for documentation, or find additional supporting information. Most bus maps only show single lines, not separate routes.

Helpful Hints:

- New RTD/mass transit stops can be requested for a new building with a sizable population.
- The designation of a new public transit stop can be achieved with only the addition of a sign (i.e. requiring the bus to stop if a rider is present.) Many project teams incorrectly assume a transit stop shelter or bench is necessary and therefore expect a higher cost impact to achieve the credit.
- Colleges, universities and schools are often located in close proximity to the required public transportation; however, school buses that are not open to the public do not count toward credit achievement.

Example:

- Boulder Community Foothills Hospital (BCFH) was sufficiently confident in its employee ridership of RTD that it constructed an additional bus stop along Arapahoe Drive. The intent is to have RTD take over ownership and maintenance of the stop in the future. In addition, the Hospital has a company policy to provide Eco Passes (bus passes) to all BCFH employees, and received a waiver from the City to build 25 percent less parking capacity than code required. BCFH earned SSc4.1 and was able to earn an additional Innovation in Design credit for exemplary promotion of Alternative Transportation.

QUICK FACTS

Implementation: Strongly recommended.

Historical Data: 71% of Colorado LEED certified projects have successfully earned this credit.

Boulder Community Foothills Hospital
Additional bus stop
Courtesy: Boulder Associates, Inc.

Resources:

The Regional Transportation District
The RTD website includes bus routes that serve the Denver Metro and surrounding areas.
Website:
www.rtd-denver.com/

American Public Transportation Association
The American Public Transportation Association has a Colorado Transit Links web page that includes links to local public transportation agencies by county. This resource can be used to look up routes that serve the project location.
Website:
www.apta.com/links/state_local/co.cfm

SS Credit 4.2: Alternative Transportation, Bicycle Storage & Changing Rooms

Many communities in Colorado are particularly friendly to bicycle commuters, and Colorado in general has a very high number of bicycles per capita. This credit is attractive to many building owners and occupants and is relatively inexpensive to achieve (if occupant accessible showers are planned and/or desirable).

Recommendation:

- Ensure the design includes convenient changing locations, as well as showers.

Helpful Hints:

- Showers and changing facilities can be located in a neighboring building as long as it is within 200 yards of the building and occupants will be able to use the facilities.
- LEED-NC 2.1 states that *covered* bike storage is required for 15 percent of the building occupants in residential buildings.
- Most bicycle racks accommodate two bikes, so the quantity on the plans may be one-half of the number required for the LEED calculation.
- While bicycle storage is required for five percent or more of full-time building occupants, remember shower/changing facilities are one for every eight bicycling occupants (or storage slots).
- Although visitors must be used in the calculation for the number of bike storage slots, they are not required to be included in the occupant count for calculating the number of shower/changing areas. Visitors or 'transients', are defined as people who stay at the building for less than seven hours. (For example students attending class, or visitors coming to a recreation center or a hospital).
- Note, in general, the calculations for credits 4.2, 4.3, and 4.4 should be rounded up to the next whole number (i.e. a calculation of 5.2 requires 6 bike storage slots be installed).

QUICK FACTS

Implementation: Strongly recommended.

Historical Data: 93% of Colorado LEED certified projects have successfully earned this credit.

North Boulder Recreation Center
Courtesy: Architectural Energy Corporation

Examples:

- Boulder Community Foothills Hospital installed over sixty (covered) bicycle racks in their underground parking facility.
- The University of Colorado ATLAS Building is providing showers accessible to all building occupants as well as showers in dressing rooms with limited access. Only showers that are accessible to all building occupants qualify for the credit.

Resources:

Building Green
Green Spec
This resource includes links to bicycle storage manufacturers, articles and case studies related to alternative transportation (*GreenSpec requires paid subscription).*
Website:
www.buildinggreen.com/auth/productsByLeed.cfm?LEEDCreditID=5

SS Credit 4.3: Alternative Transportation, Alternative Refueling Stations

This credit has been highly criticized because of the apparent futility due to the lack of electric vehicles in use today. Many projects have not pursued this credit under LEED version 2.1; however, alternative compliance paths including providing hybrid vehicles for building occupants have been approved through the Credit Interpretation Ruling (CIR) process.

Recommendations:

- Alternative compliance paths make this credit more feasible than it may first appear. It can be achievable either for campuses that use electric maintenance vehicles for transport or for companies that wish to provide low emitting and fuel efficient fleet vehicles.
- Electric recharging stations can be added late in the project if proper electric cabling is available. Several projects have elected to run conduit or cable out to the parking area early in the project when it is much less expensive to do so, in order to leave the option of later installation of the recharging stations.

Helpful Hints:

- Note that the requirement is for the total number of cars that can be fully recharged within the service limits of the station and normal operating hours. Typically two cars can be recharged over eight hours, cutting the number of chargers required in half. Signage is also required.
- Supplying fleet vehicles with biodiesel fuel can be an acceptable approach to achieving the intent of this credit. See CIR under SSc4.3 dated 3/30/05 for further explanation.
- Charging stations must be installed for credit achievement. 120 Volt or 240 Volt exterior outlets do not comply.
- Purchasing a fleet of hybrid vehicles can meet credit requirements.
- Contracting for the use of shared cars has also been demonstrated to meet the credit intent.

QUICK FACTS

Implementation: Worth considering.

Historical Data: 29% of Colorado LEED certified projects have successfully earned this credit.

Examples:

- The North Boulder Recreation Center was able to achieve this credit early in the history of the LEED rating system with conventional 120v exterior outlets installed in the light poles in the parking lot. Multiple subsequent CIRs have provided much stricter requirements for the qualifications of a recharging station.
- The U.S. Department of Transportation more recently was awarded LEED credit for installing 13 *qualified* rechargers in the project.

Resources:

Colorado Greening Government
Transportation
Information about alternative fuels, carpooling and resources for state agencies and others
Website:
www.colorado.gov/greeninggovernment/programs/transportation

Governor's Office of Energy Management and Conservation
Transportation & Alternative Fuel Programs
Includes tax credits
Website:
www.state.co.us/oemc/programs/transportation/index.htm

U.S. Department of Energy- Energy Efficiency & Renewable Energy
Alternative Fuels Data Center- industry contacts, FAQs
Interactive fuel station mapping system, listings of available alternative fuel vehicles, and more.
Website: www.eere.energy.gov/afdc/
Incentives: www.fleet-central.com/af/fleet_incentives/articles/incentives_altfuel.pdf

SS Credit 4.4: Alternative Transportation, Parking Capacity

This credit restricts parking capacity for the project to the minimum amount of parking required by local code and has an additional requirement for designated carpool spaces. Even if parking is not part of the project, carpool spaces must be provided in the surrounding area (or nearby parking lots) to achieve this credit.

Helpful Hints:

- Existing parking stalls can be converted into reserved carpool stalls by adding signage posts or pavement markings.
- This credit can be difficult to achieve in retail settings due to high parking requirements.
- In residential projects the credit may be achieved by providing a car-share program serving at least five percent of the residential occupants.
- Special provisions from the Application Guides for Lodging and Campuses may apply.

Examples:

- While the University of Colorado ATLAS building does not provide any new parking, the University is designating carpool parking spaces in a nearby existing parking structure.
- Boulder Community Foothills Hospital was successful in getting a variance from the City of Boulder to install a parking capacity 25 percent below that required by local code.

QUICK FACTS

Implementation: Strongly recommended.

Historical Data: 43% of Colorado LEED certified projects have successfully earned this credit.

U.S. Department of Transportation
Preferred parking carpool spaces
Courtesy: Opus Northwest

SS Credit 5.1: Reduced Site Disturbance, Protect or Restore Open Space

This credit can be achieved in two ways. If your site is a Greenfield (undeveloped) site, the requirement calls for limitation of site disturbance. For previously developed sites, the requirement is to restore 50 percent of the site area (excluding the building footprint) with native or adaptive vegetation.

Recommendations:

- Engage the landscape architect early so that they know to incorporate native or adaptive vegetation in the original landscape design.
- In Colorado, using native or adaptive vegetation has some synergies with WEc1.1, Water Efficient Landscaping.
- This credit is not easily achievable for projects on zero lot-line sites.

Helpful Hints:

- Most projects find it hard to comply with the greenfield option for this credit because of clearing or grading during site preparation.
- For previously developed sites, though restoration of 50 percent of the site area (excluding the building footprint) can be easy to achieve, it is the restoration with native/adaptive plant species that can make the credit more difficult. The USGBC characterizes native or adaptive species as an area that will not be mowed.
- CIR SSc5.1 6/26/2003 states that areas that have been disturbed may be classified as "previously developed" even if no building was erected on the site depending on previous site conditions and uses.
- Agricultural land may qualify as previously developed; however, if the land is lying fallow and has been allowed to return to its natural state, it will be considered a greenfield site.

Example:

- The North Boulder Recreation Center is the only Colorado project to date to earn this credit. The City restored 50 percent of the project site by transplanting existing trees, preserving existing trees, installing fescue grass and planting native shrubs.

QUICK FACTS

Implementation: Worth considering.

Historical Data: 7% of Colorado LEED certified projects have successfully earned this credit.

Resources:

NCAT - Smart Communities Network
Open Space
This resource can be used to gather examples and guidelines for reducing site disturbance.
Website:
www.smartcommunities.ncat.org/landuse/open.shtml

Stapleton, Colorado
Emphasizing the preservation of open space, the reduction of pollution and the conservation of natural resources, the Stapleton Development Corporation is constructing a community comprising a network of urban villages, employment centers and greenways on the 4,700-acre former site of Stapleton International Airport near Denver.
Website:
www.smartcommunities.ncat.org/success/stapleton.shtml

SS Credit 5.2: Reduced Site Disturbance, Development Footprint

To earn this credit it is necessary to exceed local zoning open space requirements by 25 percent; or in areas with no local zoning requirements, such as many college campuses or federal government projects, open space equal to the building footprint must be designated adjacent to the building. Recent CIRs have allowed projects that are within a campus setting to designate open space in other areas of the campus, if adjacent open space is not available.

Recommendations:

- This may not be a good credit to target for projects on tight building sites.
- This credit is not easily achievable for projects on zero lot-line sites

Helpful Hints:

- The designated open space required by this credit does not have to be one contiguous space, but can be pieces (within the site area) that you add together, all over the site.
- For areas with no local zoning requirements: though the LEED Reference Guide calls for open space equal to the "development footprint", the USGBC released a revision to replace "development footprint" with "building footprint" for this credit. This substantially changes the scope of designated open space for projects with large site areas, but smaller building footprints.
- Dedicating open space for the life of the project may be difficult depending on the transition of ownership and life expectancy of the building.
- In campus applications it may be possible to earn credit by dedicating open space on neighboring sites if it is paid for using the project's construction budget. In this case that total project budget would need to be applied consistently across all credits which may have negative impact on other credit calculations.

QUICK FACTS

Implementation: Recommended.

Historical Data: 71% of Colorado LEED certified projects have successfully earned this credit.

Examples:

- Boulder Community Foothills Hospital provided 62 percent open space on the project site although only 20 percent was required by code.
- Fossil Ridge High School had no local zoning requirement for open space but earned credit by providing open space greater than the area of the *building* footprint.
- The Tutt Science Center at Colorado College provided a letter from the college's Board of Trustees dedicating the appropriate area as open space for the life of the building.

Resources:

Colorado Office of Smart Growth
Dedication Requirements- Protecting Colorado's Open Space
Includes background on city initiatives for open space zoning requirements as well as example open space dedication requirements for a number of cities (see page 6).
Website:
www.dola.state.co.us/SmartGrowth/Documents/Openspacededication.pdf

Aspen Valley Land Trust
Colorado Conservation Tax Credits
Colorado taxpayers can promote the preservation of open space by purchasing conservation easement tax credits.
Website:
www.avlt.org/docs/AVLT_TaxCredits.pdf

SS Credit 6.1: Stormwater Management, Rate & Quantity

Though *some* jurisdictions require stormwater management that will fulfill the requirements of this credit, this credit can be difficult to achieve in Colorado. While it is relatively easy to decrease the *rate* of stormwater run-off through design, it can be difficult to reduce the *quantity*, particularly if there is more impervious area post-development than pre-development. *Retention* ponds are generally discouraged in permitting due to Colorado's unique water right laws and the risk of West Nile Virus from standing water. However, *detention* ponds are allowed and will contribute to the achievement of this credit.

Recommendation:

- The use of pervious paving materials, bioswales, green roofs and/or stormwater reuse are examples of design strategies which assist to achieve this credit.

Helpful Hints:

- When doing the calculations for this credit do not overlook run-off from the roof.
- The stormwater management for this credit can be costly depending on the design.
- Underground water storage has become more prevalent, but can be costly.
- Many of the strategies used for this credit will also contribute to SSc6.2.
- LEED uses a two-year storm event as the basis for the LEED SSc6.1 calculation.
- Typical stormwater management solutions such as cisterns or roof catchment systems are not allowed in most Colorado jurisdictions.

Examples:

- The North Boulder Recreation Center decided against pursuing this credit because they did not want to construct a detention pond close to a residential area.
- The Tutt Science Center at Colorado College was able to achieve a 3.6 percent reduction in the quantity of water run-off. However, since over 50 percent of their original site was impervious they did not achieve LEED credit since a 25 percent reduction was required.

QUICK FACTS

Implementation: Worth considering.

Historical Data: 21% of Colorado LEED certified projects have successfully earned this credit.

Fossil Ridge High School constructed pond allows on-site stormwater runoff to be detained for irrigation

- Fossil Ridge High School constructed detention facilities to control the discharge of stormwater, and the entire quantity of two-year storm water is retained on-site and used for irrigation.

Resources:

U.S. Environmental Protection Agency
Stormwater Best Management Practice Design Guide
The Stormwater Best Management Practice Design Guide includes information with respect to; watershed factors, terrain factors, physical site factors, community and environmental factors, and location and permitting factors.
Website:
www.epa.gov/ORD/NRMRL/pubs/600r04121/600r04121.pdf

The Stormwater Manager's Resource Center
Fact Sheet- Stormwater Management Practices
This resource includes a series of fact sheets on the most common stormwater management practices with quick summary descriptions of practices, including planning level cost information.
Website:
www.stormwatercenter.net/

Colorado Local Technical Assistance Program
Article: *Drainage and Stormwater Management*
The Colorado LTAP website includes information about drainage workshops, articles, current stormwater regulations and a library of reference materials.
Website:
ltap.colorado.edu/newsletter/sept02/5.php

SS Credit 6.2: Stormwater Management, Treatment

Although building codes require most projects to achieve the Total Suspended Solids (TSS) required treatment for this credit, the Total Phosphorous (TP) removal is frequently not addressed. To earn this credit, a treatment system must be installed which removes both TSS and TP.

Recommendations:

- Common strategies for reducing TSS and TP (which come from agricultural fertilizers, animal dung, etc.) in water can include bioswales, filtration basins (filters), detention ponds and vegetated filter strips.
- Work with the landscape architect to properly direct stormwater run-off from the site so that it can be treated to the requisite level before discharged.

Helpful Hints:

- Oil interceptors at parking lots do not count for this credit.
- The USGBC has ruled (CIR SSc6.2 11/9/01) that in most cases NO calculation is required for this credit. A simple narrative recorded in the LEED Template can suffice to demonstrate the suitability of the selected Best Management Practices (BMPs) to the project specifics.
- Building owners should consider cost (and maintenance labor requirement) for filter replacement in water treatment system selection.
- Roof run-off must also be treated.
- Projects do not need to account for TP removal of they can document the lack of phosphates entering the site.

Examples:

- Fossil Ridge High School achieved this credit through the use of grass-lined bioswales to collect the run-off and retain the water for irrigation.
- Boulder Community Foothills Hospital's site is adjacent to Boulder Creek so it was imperative to have high quality stormwater run-off. They were able to achieve this credit through a variety of measures including constructed wetlands, vegetated filters and a system of stormwater interceptors.

QUICK FACTS

Implementation: Recommended.

Historical Data: 57% of Colorado LEED certified projects have successfully earned this credit.

Boulder Community Foothills Hospital site design protects nearby Boulder Creek

Resources:

The Stormwater Manager's Resource Center
Stormwater Management Fact Sheet: On-Lot Treatment
A great source of treatment methods, design considerations, cost, etc. This fact-sheet references residential development, but applies to commercial development as well.
Website:
www.stormwatercenter.net/Assorted%20Fact%20Sheets/Tool6_Stormwater_Practices/On-lot/Onlot.htm

U.S. Environmental Protection Agency
Managing Urban Stormwater: Treatment Techniques
This paper, written by the NSW Environmental Protection Authority, describes non-proprietary stormwater treatment techniques and could be a valuable resource for information about treating stormwater.
Website:
www.epa.nsw.gov.au/resources/treattech.pdf

Governor's Office of Energy Management and Conservation
Treating Wastewater With Constructed Wetlands
This report is the product of a multidisciplinary task force assembled to demonstrate the benefits and applicability of wetlands for wastewater treatment. The website also includes resources linked to "best practices" learned.
Website:
www.state.co.us/oemc/programs/waste/wetlands.htm

U.S. Environmental Protection Agency
Clean Water State Revolving Fund
The Clean Water State Revolving Fund (CWSRF) programs provided about $4 billion annually in recent years to fund water quality protection projects for wastewater treatment, nonpoint source pollution control, and watershed and estuary management.
Website: www.epa.gov/OW-OWM.html/cwfinance/cwsrf/index.htm

SS Credit 7.1: Landscape & Exterior Design to Reduce Heat Islands, Non-Roof

This credit's difficulty depends greatly on the amount of asphalt or other dark impervious surfaces on the project site. Strategies are discussed in terms of *albedo*, a measure of reflectivity of a surface. There are three main strategies that are most often used to achieve this credit: use of high-albedo impervious surfaces, shading of low-albedo impervious surfaces or underground or covered parking. This credit can be achieved fairly easily, and at a no-cost premium, if the only impervious areas you have on your site are concrete side walks or concrete parking areas. In this case, the credit can most likely be achieved with the albedo value of standard concrete. However, if large asphalt parking areas are planned for the project, it is best to supply covered (or shaded) parking. Some projects with uncovered asphalt paved parking have been able to achieve this credit by combining areas of standard concrete, light colored hardscaped areas, and shading from trees on the asphalt to produce a weighted average calculation for the total site. Structured or underground parking, where the surfaces are shaded, automatically qualify the project for this credit.

Recommendation:

- In Colorado, with its particularly strong solar radiation, achieving this credit makes the site more appealing and comfortable for the building occupant, and can reduce building cooling loads.

Helpful Hints:

- Standard grey concrete complies with credit requirements as a high albedo product.
- If using a weighted average calculation, specifying white (high reflectance) cement can greatly increase the average reflectivity of your impervious areas. This is a potential cost increase above standard asphalt paving.
- In campus applications check campus standards for acceptable concrete mixes. Light or colored concrete may not be acceptable.
- Pervious pavement is required to meet the same reflectivity standards as other hard surface areas such as concrete.
- Shading of non-roof impervious site surfaces is calculated on June 21 at solar noon.

QUICK FACTS

Implementation: Strongly Recommended.

Historical Data: 50% of Colorado LEED certified projects have successfully earned this credit.

Fossil Ridge High School uses concrete and trees to minimize heat island
Courtesy: RB+B Architects

Examples:

- Belmar Block 2 achieved this credit by providing more than 50 percent of its parking underground.
- Fossil Ridge High School achieved this credit primarily by using concrete for a large plaza area and sidewalks and by providing shade trees in the parking areas.

Resources:

See Landscape and Exterior Design to Reduce Heat Islands, Non-Roof credit (SSc7.2).

SS Credit 7.2: Landscape & Exterior Design to Reduce Heat Islands, Roof

Reducing roof heat islands can be achieved by installing high reflectance roofs and/or garden roofs. High reflectance roofs (most commonly white membrane roofs) are becoming more prevalent with numerous color options, and have less and less of a cost premium compared to standard roofing materials. Garden (or "green") roofs in Colorado can be a design and permitting challenge. The intensity of the sun and minimal rainfall make the plant pallet small, and irrigation necessary. Though garden roof tops can have a considerable cost impact on the project, they may have a higher resale value to high-rise residential and office buildings. Garden roofs also help contribute to achieving credits SS 6.1 and 6.2 and EA credit 1, but may hurt irrigation requirements for WE credit 1.

Recommendations:

- Most commercial buildings are internally load dominated and benefit from a high reflectance roof by reducing the cooling load. However, elementary schools and other buildings may not benefit. Energy modeling can aid in this choice.
- Particularly in buildings with packaged rooftop units, a white roof contributes to a reduced cooling load by avoiding excess "pre-heating" of the intake air from a hot dark roof.

Helpful Hints:

- High-albedo standard roofs do not only mean white roofs. High-albedo roofs now come in a wide variety of colors and styles.
- Membrane roofs in kitchen/restaurant applications may require extra precautions (e.g. second layer of membrane), as they quickly degrade under grease exhaust.
- Confirm roofing cutsheets include the appropriate ASTM standards (emissivity and reflectance) required by this credit, as well as the ENERGY STAR rating.
- Calculation methods that average the reflectance over the net roof area may be used to show compliance.
- Garden roofs may be difficult to permit in jurisdictions where they have not yet been applied.

QUICK FACTS

Implementation: Recommended.

Historical Data: 43% of Colorado LEED certified projects have successfully earned this credit.

GSA Federal Department of Transportation
Lakewood office building's white membrane roof
Courtesy: Opus Northwest

Examples:

- Both Boulder Community Foothills Hospital and the Department of Transportation Building had to provide additional information from the product manufacturer on test results and the standards used for the USGBC to award this credit. Recently, manufacturers are making compliance information more readily available.
- Fossil Ridge High School achieved this credit through the use of an ENERGY STAR rated membrane roof.
- The University of Colorado researched roof tiles to find products that matched the architectural signature of the tile roofs on campus, yet also met the properties required to qualify as a cool roof product.

Resources:

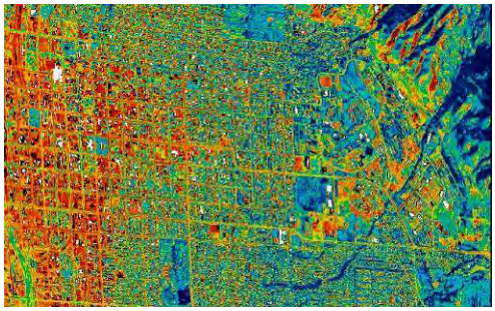
The Heat Island Group
The Heat Island Group is a research group from Lawrence Berkeley National Labs that has researched and gathered information on the effects of urban heat islands. This resource includes publications, information on the cause of the heat island effect and ways to mitigate it.
Website:
www.harc.edu/mitchellcenter/download/HIRIREV.pdf

EPA: ENERGY STAR
Refer to this website for ENERGY STAR labeled roofing products.
Website: www.energystar.gov

Cool Roof Rating Council
The Cool Roof Rating Council (CRRC) is an independent and non-biased organization that has established a system for providing Building Code Bodies, Energy Service Providers, Architects & Specifiers, Property Owners and Community Planners with accurate radiative property data on roof surfaces that may improve the energy efficiency of buildings while positively impacting our environment.
Website: www.coolroofs.org/

USGBC News
Article: *Is the Future of Roofing Industry 'Green'?*
Written by Anand Natarajan, presents components, manufacturers and applications (3/16/2006)
Website:
www.usgbc.org/News/USGBCInTheNewsDetails.aspx?ID=2271

Whole Building Design Guide
Extensive Green Roofs
Detailed information about features, leak detection, wildlife habitat, codes and standards, and photos.
Website: www.wbdg.org/design/greenroofs.php



Urban Heat Island Effect: Salt Lake City
This NASA photo illustrates the heat island effect for downtown Salt Lake City (left) which appears hotter than less developed areas (right). Photo was taken on July 13, 1998 at noon. Dark vegetative areas are at a temperature of about 90°F, while urban white 'hot spots' are at about 160°F.
Note: View/print this image in color to see heat island effect.
Courtesy: NASA/Marshall Space Flight Center

Science/NASA
Heat island research includes overflights of cities and infrared imaging.
Website:
science.nasa.gov/newhome/headlines/essd21jul98_1.htm

U.S. Environmental Protection Agency
Heat Island Reduction Initiative
The Heat Island Reduction Initiative website includes information on urban heat islands and strategies to reduce them.
Website:
www.epa.gov/heatisland/

SS Credit 8: Light Pollution Reduction

This credit requires the electrical engineer or lighting designer to produce a photometric plan which plots the footcandles of light on the site. Documentation verifying that the maximum candela value of interior lighting does not fall out through the windows of the building is also required. Footcandle plots must show the illuminance level (footcandles) at the site boundary. Note that site boundaries must be consistent for all LEED credits. This credit is more difficult to achieve in high-density areas, retail applications and sites with tight boundaries. LEED does allow certain allocations for required security lighting that exceed the credit requirements; see the CIRs for additional information.

Recommendation:

- Work with the electrical engineer or lighting designer to confirm all exterior lights have the appropriate IESNA cut off designation.

Helpful Hints:

- Exterior luminaires with lamps over 1,000 lumens must be shielded and those with lamps of 3,500 or more lumens must be full cut-off fixtures, as defined by IESNA.
- If city street lights are being installed as part of the project scope and they are located within the project's site boundary, these fixtures must comply with credit requirements.
- In campus settings, a project need not have zero footcandles at the site boundary and can take a comprehensive approach to the campus lighting plan. See the LEED Campus Application Guide for more details.
- Projects should be especially cautious with monument, flagpole and signage lighting, artistic or building up lighting and landscape up lighting.
- Special consideration should also be taken when projects are required to match business complex, campus, or city fixture standards.

Examples:

- The Belmar Block 2 project team decided not to pursue this credit in a retail setting.

QUICK FACTS

Implementation: Recommended.

Historical Data: 50% of Colorado LEED certified projects have successfully earned this credit.

The North Boulder Recreation Center
Full cutoff and shielded exterior luminaires minimize might trespass
Courtesy: Barker Rinker Seacat Architecture

Resources:

Illuminating Engineering Society of North America (IESNA)
IESNA provides a variety of reference material including Advance Lighting Guidelines and the IESNA Lighting Handbook.
Website: www.iesna.org

International Dark Sky Association
This association is dedicated to reducing night-time light pollution.
Website: www.darksky.org/index.html